

Grooved-in Pavement Markings on Moab Main Street



UDOT Maintenance Methods Study

Ken Berg, P.E. Product Evaluation Engineer

Acknowledgements

■ UDOT

■ Central Maintenance

- Rich Clarke, Maintenance Engineer
- Lloyd Neeley, Deputy Maintenance Engineer
- Vincent Liu, Maintenance Methods Engineer

■ Region 2

- Dan Betts, Operations Supervisor

■ Region 4

- Pat McGann, Area Supervisor
- AJ Rogers, Area Supervisor
- Moab Maintenance Station Crew
- Price District Paint Crew

■ Industry

- Flint Trading (PreMark® preformed thermoplastic)
- Comax (grinding)

■ Moab City Officials

Grooved Waterborne Successful on I-80 shoulders and skips...



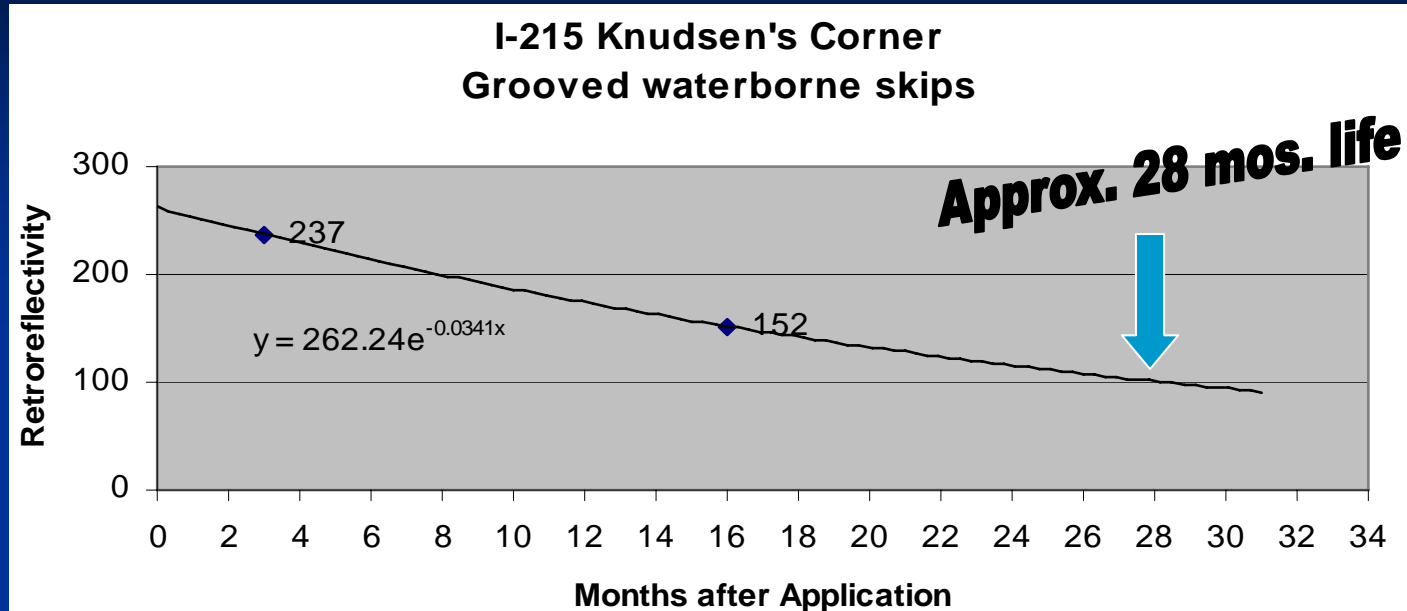
- I-80, Salt Lake Valley, west side near Great Salt Lake
 - Concrete Pavement
 - Heavy plowing, high AADT
 - Installed Sept. 2006
 - Still looks good after two winters

and on I-215 skips...



- I-215, Salt Lake Valley, east bench
 - Concrete pavement
 - Heavy plowing, high AADT
 - Difficult to maintain markings through the winter
 - Installed on skips June 2005 still looked good early spring of 2008

I-215 Life Projection



- Grooved 60 mils in skips
- Applied state spec waterborne
- Mobile retros averaged over all lines for given date
- Good presence after 3 winters

...and SR-6 in Spanish Fork Canyon



- Mouth of Spanish Fork Canyon to Diamond Fork turn-off (7 miles)
 - Installed Sept. 2007 on a new microsurface
 - Pictures taken Mar. 2008—loads goods after a severe winter

Moab Seemed a Good Choice

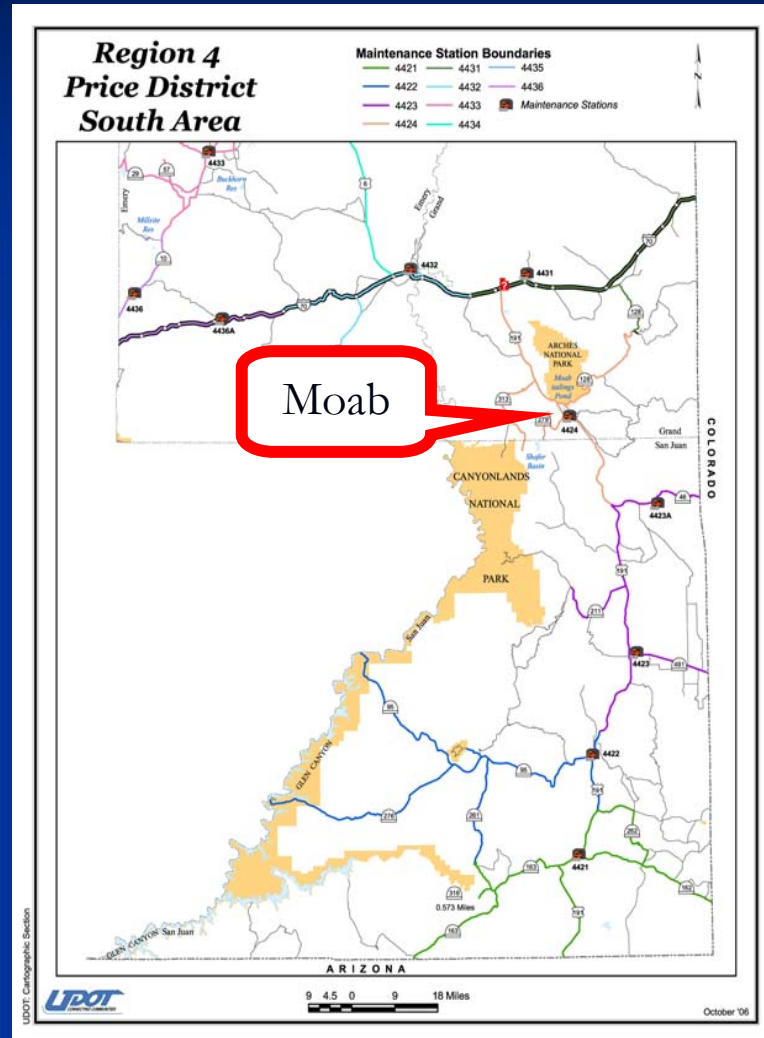
- Pavement reconstruction not planned for at least 5 years
- Remote location
 - Difficulty of quick response for state forces or contractors when needed during painting season
- High Wear of Messages
 - Plows
 - Seasonal high AADT
 - Needed applications at least twice a year.

Moab Background

- In Eastern Utah, 235 miles SE of Salt Lake City
- 30 mi. south of I-70
- Population - 5,000
- High mountain desert
- Snowfall - 9.2 in/yr
- Ave Temp. - 18° F to 98° F
- Mean elevation approx. 4100 ft.



UDOT Price District South Area

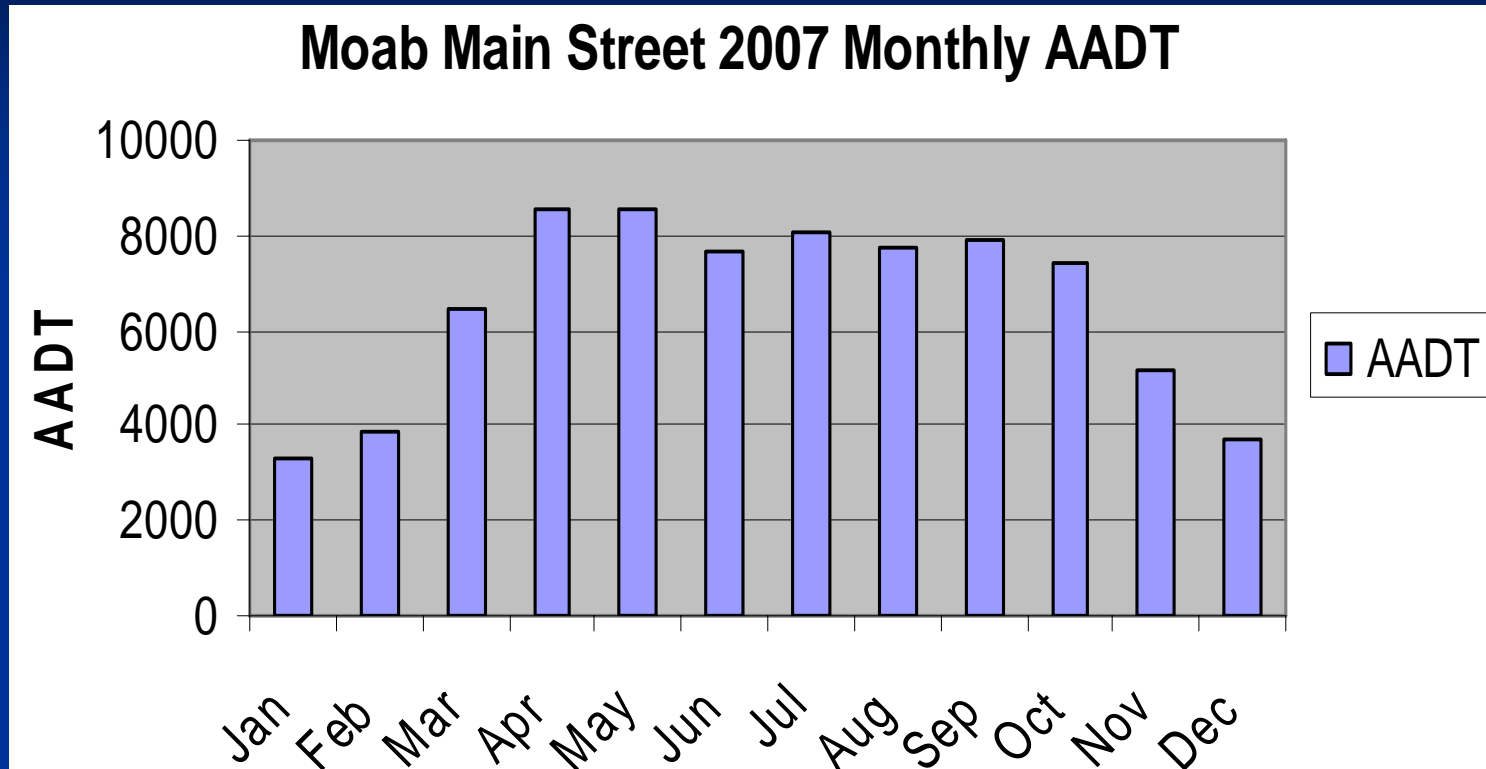


Moab Economy

- Tourist based economy
- Approx. 1,000,000 visitors per year
- Hikers in Canyonlands, Arches & Dead Horse Point
- Bikers on Slick Rock Trail
- Jeepers at the Annual Jeep Safari in March



Moab Traffic



- AADT increase during tourist season-Mar. to Oct.
- 32% trucks

2006 Reconstruction

- 200 North to 300 S., 0.5 miles
- Existing asphalt replaced with full depth PCC
- 2 phases
 - Phase I completed and painted in May 2006
 - Phase II completed and painted in July 2006
- State spec HD-21 Waterborne
 - 2 coats in some locations
 - 20-25 wet mil application
 - Messages and long lines by contractor



Marking Performance History



- Poor condition after 3 months
- Repainted by contractor when project completed in spring of 2006
- Pavement messages painted again by Price District in June 2007

Project Specifics

- Began Aug. 2007
- Grinding Contract-Comax Industries (comaxonline.com)
- Painting
 - Installation-UDOT Price District Paint Crew
 - Material- Ennis Waterborne Acrylic with Fastrack™ HD-21 resin
- Traffic Control-UDOT Moab Maint. Station Crew
- Messages (arrows, stop bars & crosswalks)
 - Installation-UDOT Price and Moab Maint. Crews
 - Material-PreMark® Preformed Thermoplastic (Flint Trading)
 - Company reps were on site for technical support

Grinding Long Lines



- 3 head, vacuum assisted, diamond grinder, dry
- 120 mils depth

Installing Lines



- Price District paint crew worked at night when traffic was minimal

Grinding Arrows



- Template used & router-like grinder
- Only known template used for arrows, others grind a square
- Challenging to achieve consistent depth because of center crown

Installing Arrows



5/8/2008

Grooved-in Pavement Markings on Moab Main Street
Ken Berg

Installing Arrows



5/8/2008

Grooved-in Pavement Markings on Moab Main Street
Ken Berg



Grinding Crosswalks & Stop Bars



Experimented using different equipment depending on working room available

Installing Crosswalks & Stop Bars



5/8/2008

Grooved-in Pavement Markings on Moab Main Street
Ken Berg



Before & After



Aug. 2007, just before grinding



Nov. 2007, 2-1/2 months later

Research Methodology

■ Long Lines

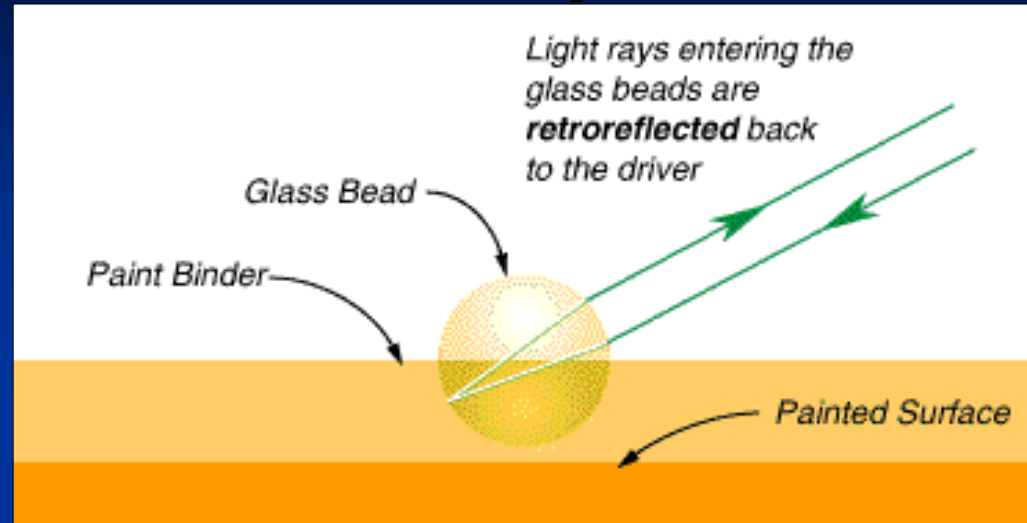
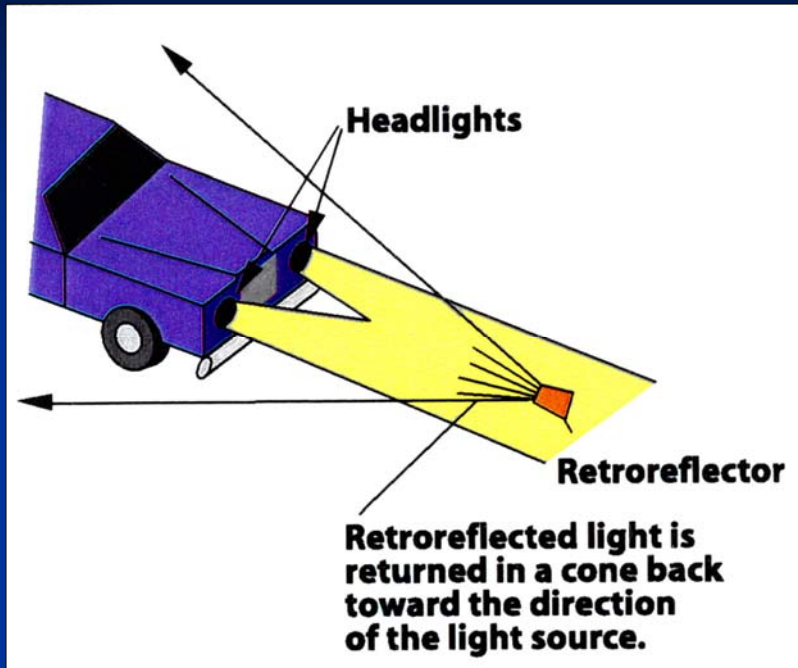
- Take handheld retroreflectivity readings at select locations (ASTM E1710-5 with LTL 2000)
- Average retro readings for a given line and date
- Plot readings using decaying exponential trendline to predict failure at 100 mcd
- Calculate cost effectiveness and compare with durable markings

■ Messages

- Readings are documented, but presence is more critical than retroreflectivity



What is “retroreflectivity”?

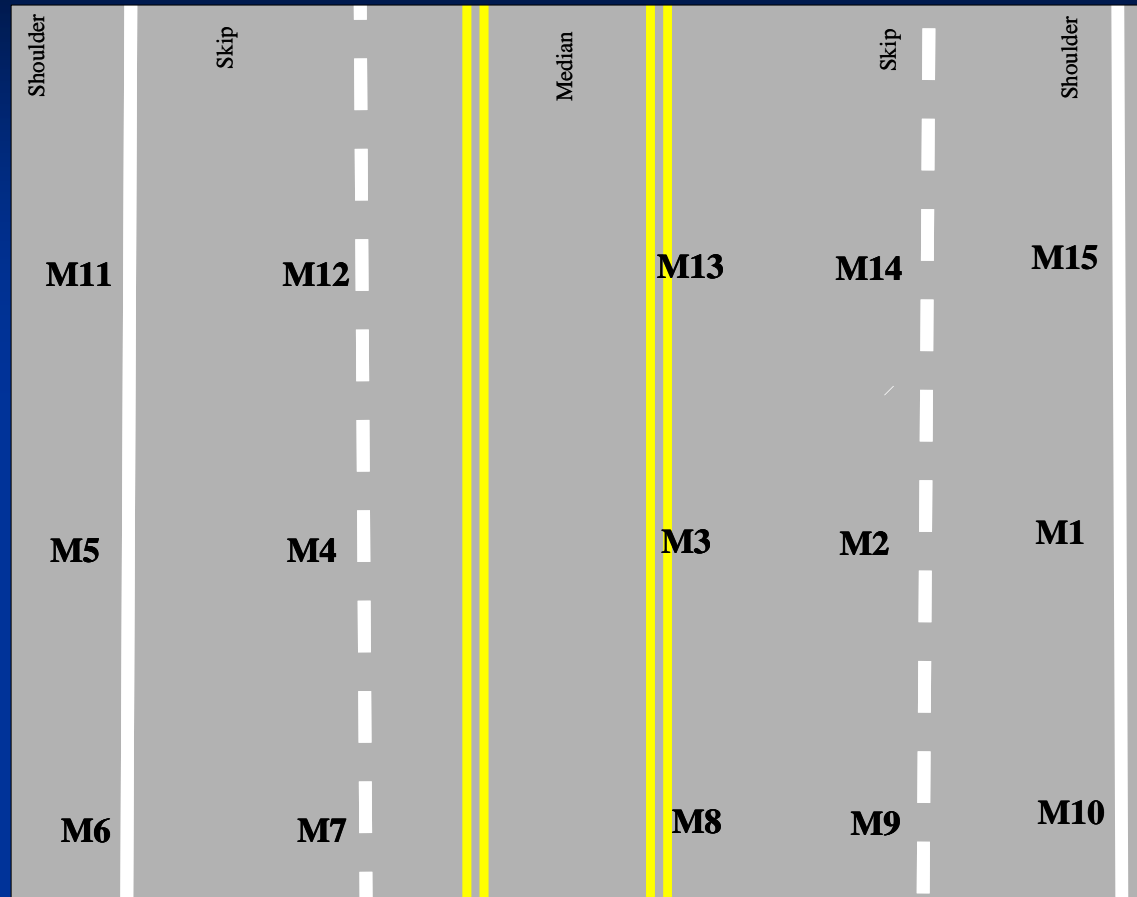


Right back atcha!

- Ability to reflect light back to light source (R_L)
- R_L is measured in units of millicandelas per square meter per lux ($\text{mcd}/\text{m}^2/\text{lux}$)
- Generally minimum range is 120-80 for long lines

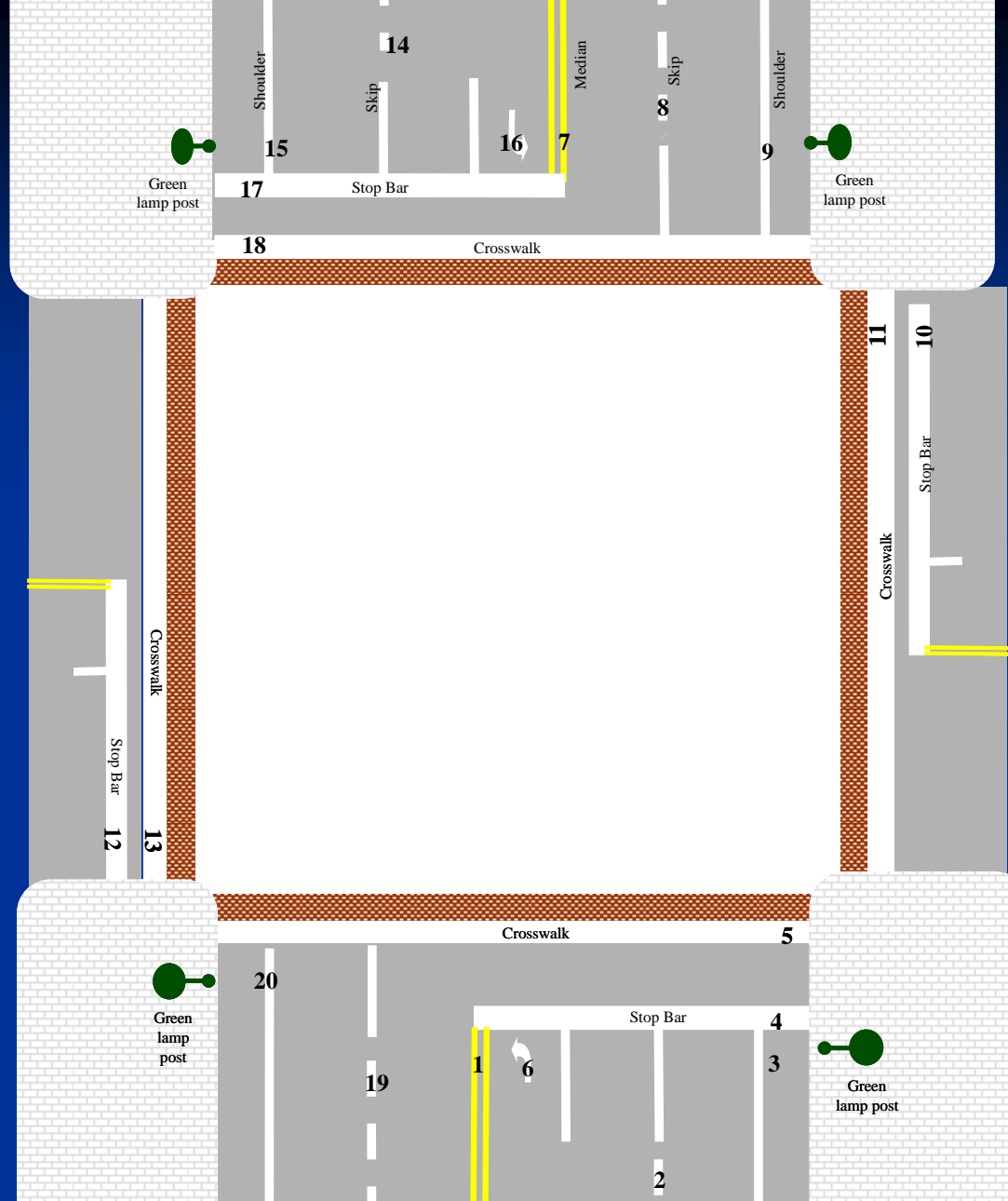
Midblock Readings

- Midblock readings taken at same location each time



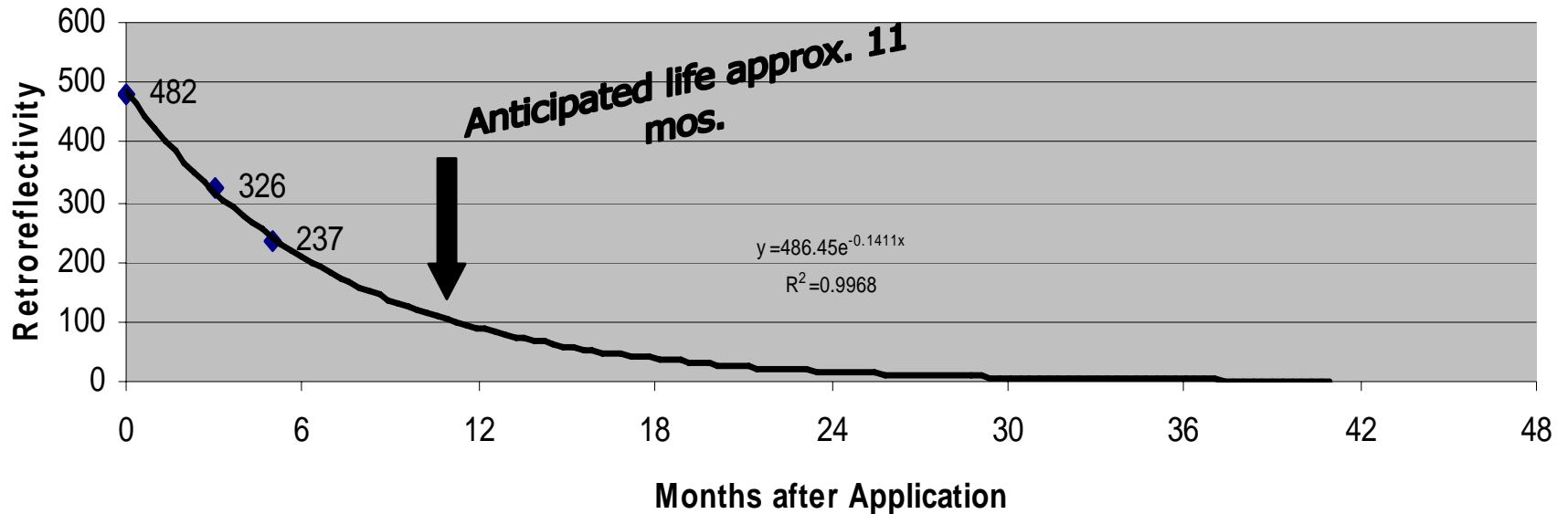
Intersection Readings

- Intersection readings also taken at same location each time
 - Rt. turn wheel paths
 - X-walks, stop bars and shoulders
 - Center of feature
 - Arrows
 - Skips



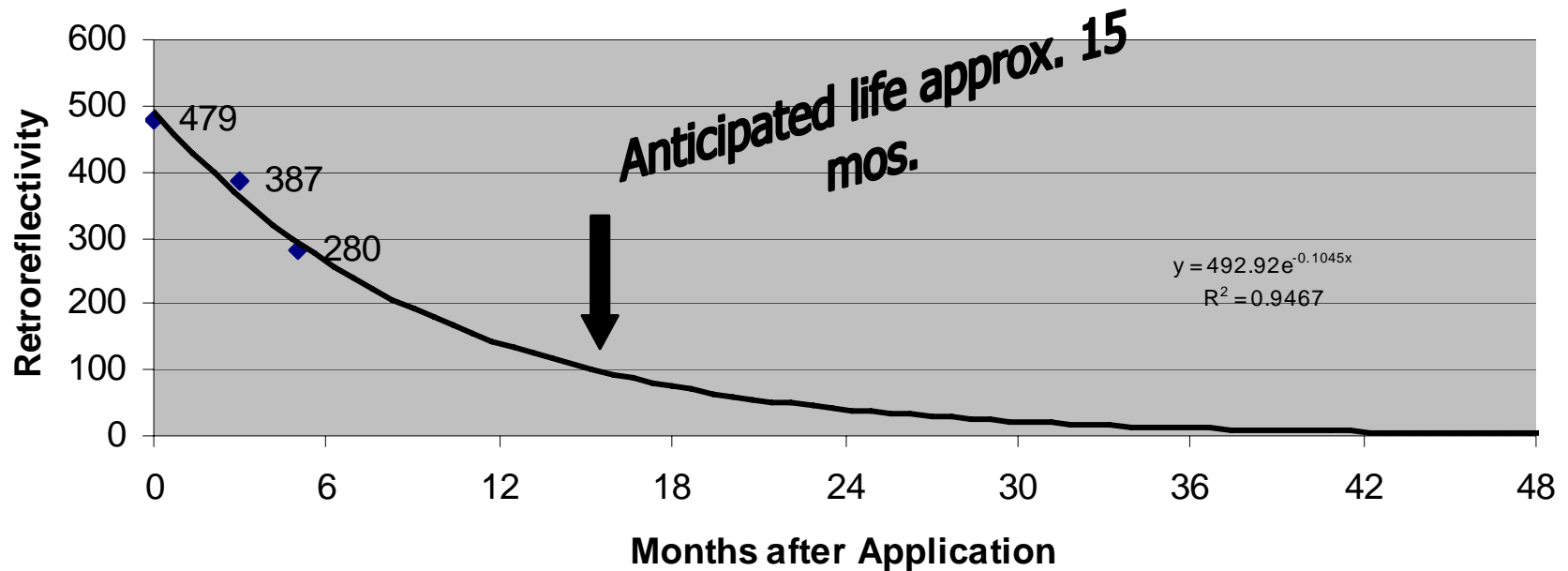
Shoulders-Projected Life

Moab Main Street Shoulders



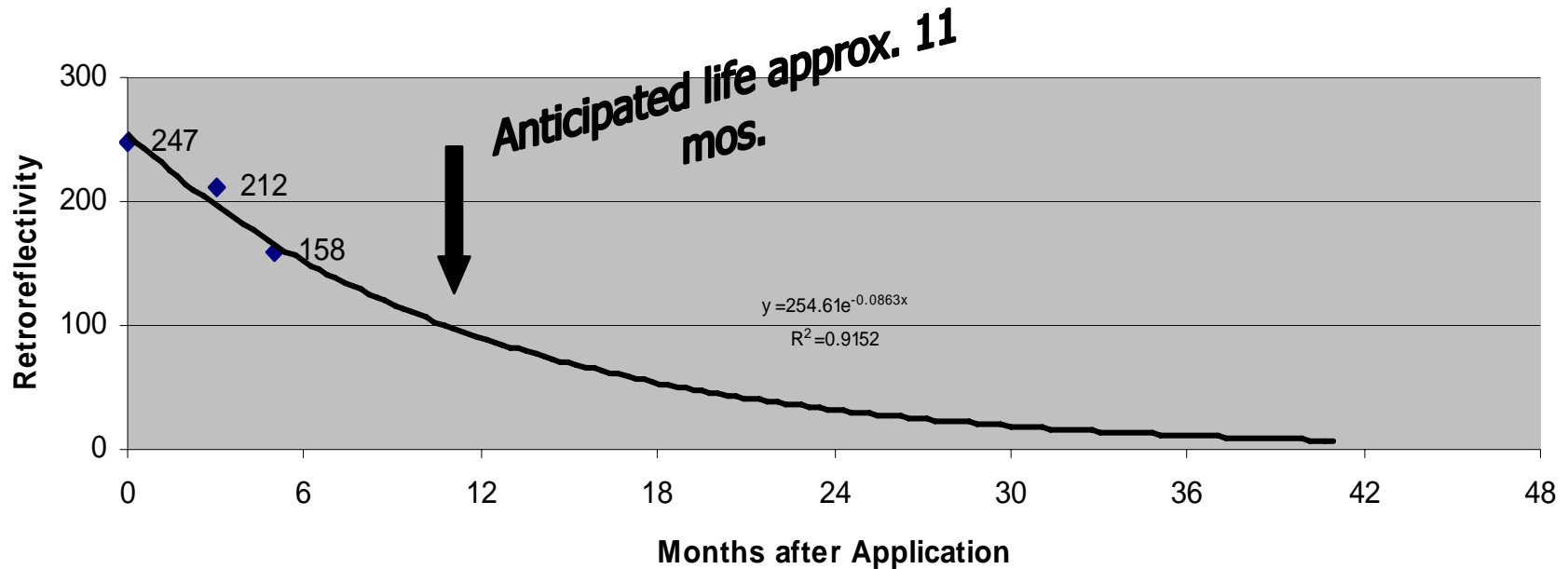
Skips-Projected Life

Moab Main Street Skips



Median-Projected Life

Moab Main Street Median



Data Analysis & Observations

- Sand on road surface caused excess wear at right turn movements
- Low (<100) initial retro readings in crosswalks and stop bars probably due to bead imbedment during heating
 - Should see retro readings increase as binder wears off and exposes beads

Cost Analysis

Moab Main Street Cost Analysis

WHITE 4" MARKING	INSTALLATION COSTS ¹ (\$/ft)			LIFE ² (yr)	YEARLY ACCUMULATED COSTS ³ (\$/ft)										TOTAL ACCUM. COST (\$/ft)	AVE. COST ⁴ (\$/ft/yr)
	Grind	Install	Tot.		Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6	Yr 7	Yr 8	Yr 9	Yr 10		
Grooved water	\$0.50	\$0.13	\$0.63	2.0	\$0.63		\$0.76		\$0.89		\$1.02		\$1.15		\$1.15	\$0.12
Ungrooved water	\$0.00	\$0.13	\$0.13	0.5	\$0.26	\$0.52	\$0.78	\$1.04	\$1.30	\$1.86	\$2.12	\$2.38	\$2.64	\$2.90	\$2.90	\$0.29
Ungrooved epoxy	\$0.00	\$0.75	\$0.75	3.0	\$0.75			\$1.80			\$2.85			\$3.90	\$3.90	\$0.39
Ungrooved 3M tape	\$0.00	\$2.08	\$2.08	4.0	\$2.08				\$4.46					\$6.84	\$6.84	\$0.68

1-Costs are 2007 and 2008 UDOT average bid prices for awarded contracts

2-Life projections based on performance on Utah roads or manufacturers warranty.

3-Additional re-striping costs and periodic removal costs are added to the accumulated costs after the marking has reached its expected service life.

Does not include traffic delay costs and are not adjusted for inflation.

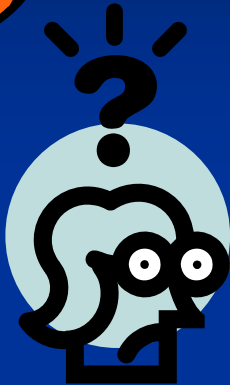
4-Average Cost per year is the Total Accumulated Cost of each marking system divided by the number of elapsed years.

Includes additional removal costs @ \$.30/ft

Summary/Conclusions

- Working well--part of operational decisions
 - Allows up to 4 applications
 - Cheapest average cost per year—(\$0.12/ft/year)
 - Local resources—UDOT & Private
- Want to learn more about:
 - Wet night reflectivity strategy
 - Different bead types and gradations
 - Different surfaces and different conditions
 - Chip Seals
 - Open Graded Surface Course
 - Microseals

Questions/Comments



Thanks!

For more info, contact:

Vincent Liu, P.E.

Maintenance Methods Engineer

vliu@utah.gov

801-965-4077

Dan Betts

Roadway Operations Supervisor

dbetts@utah.gov

801-975-4834

Ken Berg, P.E.

Product Evaluation Engineer

kenberg@utah.gov

801-965-4321